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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Gas Trace Measuring System

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A GAS TRACE MEASURING SYSTEM

Abstract

The gas trace measuring system consists of the gas sensor 2 and the actual measuring instrument (electronic evaluation circuit) 1 which also contains the display 8. In addition to the measuring cell 3, the gas sensor 2 incorporates an electronic non-volatile memory 4 in which data specific to the measuring cell are stored. These data can be read out and further processed by a computer 7 in the measuring instrument 1. Accordingly, when the gas trace measuring system is operated for the first time, the computer 7 is able to retrieve sensitivity and zero drift from the memory 4 and automatically to calibrate the instrument.

(Fig.)

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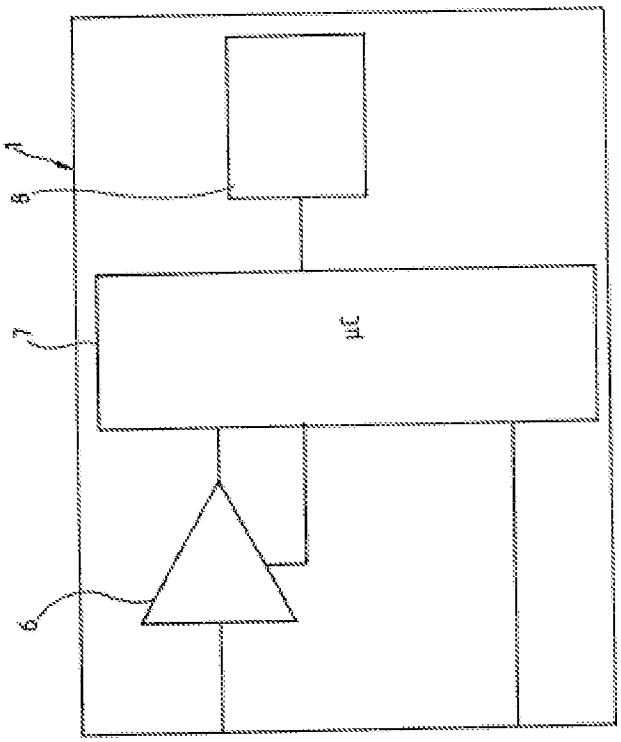
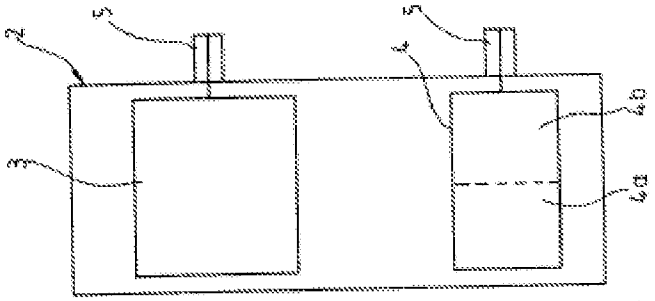


FIG1



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THE GAS TRACE MEASURING SYSTEM

This invention relates to a gas trace measuring system comprising a gas sensor and an electronic evaluation circuit with display. In known gas trace measuring systems, the gas sensor consists of a measuring cell which produces an electrical measuring signal correlated with the gas concentration to be determined. Electrochemical cells or semiconductor cells based on conductivity measurement are normally used as the measuring cell. The measuring and the electronic evaluation circuit are typically integrated into a single measuring instrument.

Gas sensors based on electrochemical cells are commonly used for the detection and trace analysis of toxic gases. One disadvantage of gas sensors of this type is their limited life (typically 1 to 2 years) which involves high maintenance and servicing costs. On account of the relatively large spread between units of these measuring cells, optimal resolution can only be achieved by individual calibration (zero value, sensitivity) of the individual measuring cells. Every time the measuring cell is changed, the measuring instrument has to be manually adjusted to the calibration data of the new measuring cell taken from the accompanying test certificate. In the case of measuring instruments equipped with different types of measuring cells, the type of sensor also has to be adjusted. This recurring adjustment work is time-consuming and involves a high risk of confusion between types of measuring cells and measuring cell data. In addition, continuous monitoring of the gas concentration is interrupted during replacement of the measuring cell, which may possibly result in production losses.

Accordingly, the problem addressed by the present invention was to develop a gas trace measuring system in which the types of measuring cell and the measuring cell

data could be checked without significant problems. As far as possible, checking would be carried out automatically by the electronic evaluation unit.

In a gas trace measuring system consisting of a gas sensor and an electronic evaluation unit, the solution to this problem as provided by the invention is characterized in that, in addition to the measuring cell, the gas sensor contains an electronic non-volatile memory in which data specific to the measuring cell are stored and in that the evaluation circuit incorporates a computer which reads out and further processes the data specific to the measuring cell.

The gas sensor with the measuring cell and the memory is best in the form of a replaceable module.

The memory is intended at least to store information on the type of measuring cell in regard to the gas component to be measured, sensitivity and zero drift.

In one advantageous embodiment, the computer retrieves the sensitivity and zero drift from the memory when the gas trace measuring system is operated for the first time and automatically calibrates the instrument.

In one preferred embodiment, the gas sensor consists of a replaceable module comprising an electrochemical measuring cell of which the characteristic data can be retrieved from the electronic memory integrated in the replaceable module.

The invention affords the following advantages:

- The calibration data supplied by the manufacturer can be stored in the memory integrated in the sensor and, in this way, are permanently and clearly linked to the measuring cell.

- Miscalibrations and resulting malfunctions of the gas trace measuring system are ruled out.

- Existing measuring instruments can be easily updated by the introduction of new threshold values, for example alarm thresholds.

- The ageing-induced reduction in the sensitivity of the measuring cell (sensitivity drift) can also be stored in the memory. Taking into account the last calibration date, which is also stored, this ageing effect can thus be compensated by the computer.

- In the version with automatic self-calibration when the gas trace measuring system is used for the first time, the sensor module can easily be replaced by unskilled personnel and requires very little servicing.

One embodiment of the invention is described in detail in the following with reference to the accompanying drawing. The drawing is a block circuit diagram of a gas trace measuring system consisting of a sensor and an evaluation circuit. The electronic evaluation circuit is accommodated in a separate measuring instrument 1. The sensor 2, which consists of the measuring cell 3 and an electronic memory 4, may be connected to the measuring instrument 1 as a replaceable module by means of a multipole plug 5. A non-volatile miniature storage unit, for example a battery-buffered RAM or EEPROM, is used as the memory. Part of the storage capacity 4a is best reserved for the sensor-specific data supplied by the manufacturer and, accordingly, should not be written over while another part 4b can accommodate user-specific data.

The measuring instrument consists essentially of an amplifier 6 to amplify the measuring signal, a microprocessor 7 and a display unit 8. The microprocessor 7 is used to process the measuring signal, to adjust the amplifica-

tion of the measuring amplifier 6, to drive the memory 4 and to futher process the data stored therein. In principle, the sensor can also be connected to the measuring instrument 1 by a single line. However, separate lines are best provided for the measuring cell 3 to the measuring amplifier 6 and from the memory 4 to the microprocessor 7. In this way, the measuring cell 3 retains its measuring function even when the microprocessor 7 is in communication with the memory 4, for example for recording and reading operations (simultaneous operation).

After calibration by the manufacturer, the memory 4 is loaded with the calibration data specific to the measuring cell and remains permanently and unmistakably connected to the measuring cell 3. After the sensor module 2 has been built into the measuring instrument 1, the memory 4 is read out by the computer 7 and recalibration is carried out automatically. Calibration is carried out, for example, by reduction of the amplification factor, for example by 10% where the sensitivity of the measuring cell 3 is 10% higher, so that a certain indication 8 is retained for a preselected concentration range. The measuring instrument 1 can be automatically calibrated every time the sensor is changed. In this way, the sensor can be changed very more quickly, even by unskilled personnel.

For example, the cell type, the zero value and the sensitivity of an electrochemical measuring cell 3 are recorded in the memory 4 by the manufacturer of the sensor module 2 after initial calibration. At the user's end, these data are read out from the measuring instrument 1 by means of the computer 7. The type of measuring cell (depending on the type of gas to be measured) can also be shown by means of the display 8. The zero value read out from the memory 4 is first subtracted from the measuring signal of the measuring cell 3 and then multiplied by the sensitivity which is also read out. Accordingly, without

any calibration or adjustment by the user, the measuring instrument 1 automatically indicates the exact gas concentration taking into account the maufacturer's individual calibration for this particular measuring cell 3. There is no longer any need for the hitherto usual manual adaptation and adjustment of the measured value in dependence upon the cell type, the zero value and the sensitivity of the cell. This signifies a considerable reduction in servicing work. In addition, there is no danger of miscalibration and hence no danger of malfunction of the measuring instrument. If the measuring cell 3 is recalibrated by the user, the new calibration data may also be stored in the memory. In this case, that part (4a) of the memory which contains the data supplied by the manufacturer, must be non-erasable.

In addition to the above-mentioned calibration parameters, the manufacturing date, the purge date, the serial number, the temperature coefficient, the calibration date, the name of the tester, alarm limits (MAC value), the integration time of the measuring instrument, the operating hours and the total gas dose measured in the sensor module 2 may also be stored in the memory. In addition, complex data, such as for example temperature effect, linearity trend or pressure dependence may also be stored in the form of polynomial coefficients. These data may be used in known manner for error detection or for correction (for example by means of a check sum).

CLAIMS

1. A gas trace measuring system consisting of a gas sensor (2) and an electronic evaluation circuit (1) with display (8), characterized in that, in addition to the measuring cell (3), the gas sensor (2) contains an electronic, non-volatile memory (4) in which data specific to the memory cell are stored and in that the evaluation circuit (1) incorporates a computer (7) which reads out and further processes the data specific to the measuring cell.

2. A gas trace measuring system as claimed in claim 1, characterized in that the gas sensor (2) with the measuring cell (3) and the memory (4) is in the form of a replaceable module.

3. A gas trace measuring system as claimed in claims 1 and 2, characterized in that the memory (4) at least contains information on the type of measuring cell in regard to the gas component to be measured, sensitivity and zero drift.

4. A gas trace measuring system as claimed in claim 3, characterized in that, when the gas trace measuring system is operated for the first time, the computer (7) retrieves sensitivity and zero drift from the memory (4) and automatically calibrates the instrument.

5. A gas trace measuring system as claimed in claims 1 to 4, characterized in that the gas sensor (2) consists of a replaceable module with an electrochemical measuring cell (3) of which the characteristic data can be retrieved from the electronic memory (4) integrated in the replaceable module.

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